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BIOLOGICAL STUDIES ON APHIDIDAE

BY

JOHN JUNE DAVIS

THESIS

FOR

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IN

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THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

John June Davis

ENTITLED Biological Studies on Aphididae

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE

DEGREE OF Bachelor of Science

J. W. Folsom
Instructor in Charge.

APPROVED: May 30. 1907

HEAD OF DEPARTMENT OF S. A. Forbes.

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Biological Studies on Aphididae

by

John June Davis

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Introduction.

This paper deals principally with the biology of three of our commoner species of aphids, and includes descriptions of the different forms in all their various stages, as well as a complete bibliography of these species.

I have carried on these breeding experiments for the past two years in the insectary of the State Entomologist. Practically all of the data here given, however, were obtained in 1906. This is the first time that the life histories of these three species have been thus systematically worked out.

I am especially under obligations to Dr. J. W. Folsom, who has aided me on all parts of this paper; also to Dr. S. A. Forbes, under whose direction the writer has made the experiments.

Aphis maidiradicis Forbes.

General Statement.--The corn root-aphis was first recognized by Benjamin Dann Walsh. He found it at ~~Rockford~~ Rock Island, Ill., in 1862, where it was doing considerable damage to corn. At that time it was supposed to be a root form of the common corn leaf-aphis (Aphis maidis Fitch), which lives on the upper parts of the corn plant, while the corn root-aphis lives on the roots, as the name would indicate.

Dr. S. A. Forbes first began the study of this root-louse in 1883, and most of the facts now known relating to its life history and the means of combating it have been obtained by him or under his supervision. Up to the time when Dr. Forbes began the study of the aphid, it was, as above stated, believed to be only the root form of the corn leaf-aphis. He, however, recognized it to be a different species, and described it as such in 1891, in the Seventeenth Report of the State Entomologist of Illinois.

Last year (1906) I obtained the complete life history from the egg stage in spring to the egg of autumn.

This insect has, of late years, become of great economic importance, not only in Illinois, but also in many other states of the corn belt. Outside of Illinois it has been reported as injuring corn in Ohio, Iowa, Colorado, New York, Indiana, Kentucky, Louisiana, Mississippi, Minnesota, Maryland, Nebraska, New Jersey, Virginia, and West Virginia.

Although Indian corn is its principal food plant, the insect affects also sorghum and broom-corn, has been reported as attacking the

roots of squash-vines in Delaware and Ohio, and has been found on the roots of numerous weeds and grasses, namely, smartweed (Polygonum incarnatum), knotweed (P. persicaria), crab-grass (Panicum), purslane (Portulaca oleracea), dock (Rumex crispus and R. altissimus), Setaria glauca, S. viridis, S. germanica, S. italica germanica ochloa, fleabane(Erigeron canadensis),mustard (Brassica nigra), sorrel (Oxalis stricta), plantain (Plantago major), pigweed (Amarantus hybridus), and ragweed (Ambrosia trifida). In May, 1907, Mr. E. O. G. Kelly found them on wheat roots in a field which was in corn last year.

Life History.--During the life cycle of this aphis there appear five different forms, namely, winged viviparous females, wingless viviparous females, oviparous females, males, and eggs. Briefly, the life history is as follows: The eggs have been found hatching in the field between April 8* and May 22, and from these ten to twenty-two generations may follow. These generations are all viviparous except the last generation, which occurs during the latter part of September or in October, varying according to conditions of temperature, etc. This last generation is known as the

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*In 1906 Mr. E. O. G. Kelly looked for eggs and young of A. maidiradicis from the 1st of April. He did not find eggs until April 12, and it was not until April 17 that he found the young aphids in the field. In 1907 Mr. Kelly first found eggs March 24, (these hatched in the insectary March 26) and young aphids were found in ants' nests as early as March 29. April 15 he found the young with their beaks inserted in old corn roots, this probably being occasioned by large numbers of the weeds being killed by the very cold weather of the week before.

oviparous generation, and consists of males and oviparous wingless females. The males and females pair and the females lay eggs, usually during the months of October or November, which remain as eggs over winter.

The cage which I used for rearing this root aphid consisted of an 8- or 10-dram glass vial, containing a ball of moist cotton in the bottom and plugged at the top with a piece of cotton. In this cage a sprouting corn plant was placed, and a reserve supply of these food plants was constantly kept. The first young and the last young of each generation were placed in separate vials on corn roots, and the vials were placed in closed boxes to exclude light and thus give more natural conditions. As soon as the plant began to get old and to wilt, it was replaced by a fresh one, the aphids being transferred by means of a camel's hair brush. These conditions were probably favorable to the optimum development of the aphid.

Now follows a detailed account of the life history, as worked out by me in 1906. Eggs, which were collected at Elliott, Ill., April 12, 1906, in the nests of the common brown ant (*Lasius niger americanus*), were placed in a cage in our insectary April 16. They were first noticed to be hatching April 17. Young aphids hatching April 18 and 19 were placed on corn roots in vial cages, and in this way two lines of generations were started, both of which were carried through to the egg in the fall. These so-called stem-mothers, that is, those hatching from the egg, produced their first young May 1 and 4, respectively, and their last young May 18 and 14, respectively. Taking the first young *of the first young* all the way through the series, twenty-two generations were obtained, counting the oviparous generation as the last. On the other hand,

beginning with the last to be borne by the aphid which hatched April 18, and following down the series of the last borne of each generation, there were but eleven generations in all. From this it follows that the mean number of generations for the year is sixteen and a half. The first generation lasted for thirty-one days, from April 18 to May 20; the second last during a period of thirty-four days; and the third for a period of thirty-six days. The fifteenth generation proved to be the longest, continuing for one hundred and twenty-nine days. Then the period of each generation diminished successively. These data, however, were taken from only one line of generations, that is, the generations obtained from a single stem-mother, isolated in the spring. If we take into consideration the amount of time during which eggs are hatching in the field--and eggs have been found hatching in the field from April 8 until May 22, a period of forty-four days--it will be found that all of the generations might be in the field much longer than my insectary experiments would indicate. On May 1, aphids of the first two generations coexisted in the insectary; on June 1, four generations, from the second to the fifth, inclusive; on July 1, six generations, from the fourth to the ninth, inclusive; on August 1, seven generations, from the seventh to the thirteenth, inclusive; on September 1, ten generations, from the eighth to the seventeenth, inclusive; on September 12, eleven generations, from the ninth to the nineteenth, inclusive; and between September 30 and October 24 there were twelve generations in existence, from the tenth to the twenty-first, inclusive, this being the largest number of generations in existence at any one time. From that date on, the number of generations in existence at any one time rapidly diminished in number until December 21, at which time all of the aphids were dead. The

latest date of the birth of an aphid of the viviparous generation was October 7, and the last aphid of this generation died November 28. The first record of the bisexual oviparous generation in the insectary, in 1906, was October 2, and eggs were found a few days later. Aphids of this generation continued to be born as late as November 4, and aphids were still alive until December 21. However, in 1905, I found aphids of this oviparous generation as early as September 5; also they were found *in copula*, and eggs were found as early as September 30. Bisexual forms may appear in any generation, providing the environmental conditions are such as to favor their development. Thus in the insectary sexual forms appeared in October and November from twelve different generations, varying from the eleventh to the twenty-second, inclusive. The appearance of the sexes is evidently conditioned by the temperature. This is illustrated by the occurrence of sexual forms on September 5, 1905, at which time the weather was quite cool for that time of the year, though in 1906 the sexual forms did not appear until October 2, the weather up to that time being milder than in 1905. Between April 2, 1890, and January 17, 1893, Professor M. V. Slingerland carried *Myzus achyrantes* Monell through sixty-two generations, by keeping the temperature uniform. Although further experiments would be necessary for positive proof, still, from what is now known, it appears to be true that with the necessary conditions for the development of young--food and heat--the aphids would be able to reproduce parthenogenetically for an indefinite period. Numerous records were made by me of instances in which the first young were viviparous and the last oviparous. In these cases it was noticed that after the production of viviparous forms the aphid would rest a few days without producing young before beginning to produce the

the sexual forms.

Viviparous Generation.--In 1906, between April 18 and October 3,one hundred and twenty-eight individual experiments were carried on with viviparous females, and the following averages are taken from the entire number of experiments. The immature stage was found to be quite variable in length, varying from 6 to 15 days, with an average of 8.1+ days. This is approximately the same as that obtained from experiments of 1905, in which, from ninety-seven records, the average length of this nymphal period was 8.3+ days. During the first few generations and also the last generation the time from the birth of an aphid until the birth of its first young was much longer than it was during the warmer summer months. The time between the birth of the first and that of the last young, likewise varied considerably, being from 3 to 40 days, the period being noticeably longer in early spring and in the fall. The average for the entire year was 10.6+ days. Usually the female would live several days after the production of her last young. The entire length of life of the aphid varied between 11 and 56 days, with an average of 20.1+ days for the year. During the summer months the aphids, as a rule, had a shorter life and produced more young than in the cooler days of the year. The average number of young per female for the year was 44.1+. The variation in the number of young was from 20 to 96; the latter number being the largest number produced by a single female. For the year, the average number of young borne by an individual female in a single day was 4.4+, the largest number being 11. However, in 1905, as many as 12 were borne in one day by one female. The average number of young, from April 18 until September 1, was, in one hundred and two ex-

periments, 4.9+; from September 1 to October 3 the average for twenty-six experiments was 2.4+ young per day, or one half as many. It may be noted, in passing, that, as the records made in ninety-seven experiments in 1905 vary only slightly from those obtained in the one hundred and twenty-eight experiments of 1906, the figures here given are probably sufficiently accurate for any year.

In 1905 a very interesting incident was noticed. A wingless aphid taken in the field June 23 was placed in an insectary cage and within the next few days gave birth to six young. It then discontinued the production of young for several days, but then became winged and produced twenty-one more young.

Buckton, in his "Monograph of British Aphides," Vol. I., p. 87, says: "Several early observers have erroneously stated that the female aphis is at different periods of her life both viviparous and oviparous. The acuteness of Newport failed him when he concluded 'that aphides,' meaning the same individual, 'deposite at one time true ova and at others produce living young.' It may be pretty certainly asserted that the viviparous aphis is never oviparous and that the converse also is true." In one experiment in 1906 an aphid born October 6 became adult October 24, and gave birth to a single young November 2. The adult did not produce any more young, and soon died. Upon an examination of her body only eggs were found.

All my aphids which were reared individually, in cages, were wingless. Other aphids, however, of the same mothers, and placed in cages containing many other aphids as well as a less abundant food supply, often became winged. In _Science_, Vol. XXI., January 27, 1903, pp. 48--49, Professor M. V. Slingerland gives an account of rearing individually sixty-two generations of _Myzus achyrantes_

during a period of two years and ten months, and that nothing but wingless agamic females were produced. From these and other evidences obtained it may be inferred that the development of the winged forms is largely caused by an insufficient food supply.

The number of molts is invariably four, the occurrence of the different molts being shown in the accompanying table. As a rule, reproduction began not until the next day after the fourth molt, though it sometimes occurred within a few hours after the molt; often in the last generations, in autumn, reproduction did not begin until two days after the fourth molt.

Oviparous Generation.--The oviparous generation was found in the insectary, in 1906, between October 2 and December 21. Records of 47 individuals of this generation were obtained; the records, however, are not complete in all cases. The length of the immature stage--from birth to adult--varied from 10 to 39 days, this latter being a very exceptional record. The average of 47 records is 16+ days. The average total life of 38 individuals was 30.9+ days, with a maximum (1906) of 50 days. In 1905 one aphid of this oviparous generation lived to the age of 61 days. A few records were made as to the number of eggs laid by individual females, and this was found to vary up to ten, which is probably not far from the actual number that is ordinarily laid, though four was the average number in the counts made. In the bodies of most all the female aphids eggs were found after death; the potential reproductive capacity of the female exceeds her vitality.

It is easy to distinguish immature males from oviparous females after the second molt, by their color. The males have a distinct reddish hue, while the females have a greenish color.

The number of molts in the oviparous generation is four, as in the viviparous generation. From the table showing the periods between the molts it appears that the males are more deliberate in their growth and require a longer time to become fully developed than do the females.

Descriptions.*

Aphis maidiradicis Forbes. Viviparous generation.

Before first molt and less than one hour old: General color pale pea green. Legs and antennae colorless and transparent. Eyes red. Measurements: length of body, 0.882 mm.; width, 0.400 mm.; antenna, 0.327 mm.

After first molt and not more than 24 hours old: General color pea green. Antennae almost transparent excepting last segment, which is darker. Only five noticeable segments in the antennae. Eyes red. Tip of beak darkened. Legs almost transparent excepting tarsi, which are almost black. Cornicles small and slightly darkened at tip. Measurements: length of body, 0.927 mm.; width, 0.509 mm.; antenna, 0.339 mm.

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* In giving the number of segments of the antennae I have not, as most writers do, counted the filament as a separate and distinct segment. There is certainly no joint between the thickened basal portion and the filament of this last segment, and thus they cannot be referred to as distinct segments.

The measurements and the observations on colors were taken from live specimens unless otherwise stated. Color terms are according to Ridgway's "Nomenclature of Colors."

After second molt and 72-96 hours old: General color pea green. Ultimate segment of antennae dark. Eyes reddish brown. Legs darker than body color. Tip of abdomen dark. Cornicles dark, being darkest at apex, short and extremely slightly incrassate in middle. Measurements: length of body, 1.418 mm.; width, 0.709 mm.; antenna (alcoholic specimen), I, 0.040; II, 0.040; III, 0.101; IV, 0.050; V, basal, 0.061; filament 0.098; total, 0.390 mm.

After third molt: General color light chromium green. Head pale brownish tint. Ultimate and part of the penultimate segments of the antennae darkened. Antenna with only five distinct segments; a slight constriction in the third shows the commencing of the formation of another segment. Eyes reddish-brown. Legs dark, the tarsus, and distal ends of the femur and tibia being almost black. Tip of abdomen dark, as are also the cornicles, which are darkest at the apex. Cornicles are noticeably longer than in preceeding stages; basal half being more or less swollen and the tip slightly dilated. Measurements: length of body, 2.063 mm.; width, 0.981 mm.; cornicles, 0.127 mm.; antenna (alcoholic specimens), I, 0.064; II, 0.064; III, 0.183; IV, 0.067 mm.; V, basal, 0.071; filament, 0.112; total, 0.561 mm.

Adult wingless viviparous female: Head black. Thoracic and first abdominal segments with median transverse black markings, the prothorax being almost entirely black.

On each side of the abdomen are two parallel rows of minute black markings; one on each side of the cornicle. These rows are not constant, the upper one sometimes being indistinct or wanting. Posterior three segments of abdomen with black transverse median markings. Eyes reddish brown. All antennae dusky excepting the third segment.Cornicles and tips of style black. Coxae,most of the femora, apex of tibiae and the tarsi black. Measurements: length of body, 2.09 mm.; width, 1.036 mm.; antenna, I, 0.036; II, 0.054; III, 0.181: IV, 0.091; V, 0.091; VI, basal, 0.109; filament, 0.118; total, 0.680 mm.

Winged viviparous female: Head black, thorax blackish, abdomen pale green with a black marking on each side of the second, third and fourth segments; transverse black markings on the last two and sometimes last three segments; a black ring around each corincle, and a few small black markings irregularly scattered over abdomen. Antennae dark; usually seven or eight sensoria on the third segment, sometimes only six; one sensorium near the apex of each of the fourth and fifth segments; several more or less distinct sensoria at the apex of the basal portion of the sixth. Eyes dark reddish brown. Cornicles and style as in wingless pseudogynes. Measurements (alcoholic specimens): length of body, 1.468 mm.; width, 0.605 mm.; length of wing, 2.33 mm.; antenna, I, 0.036; II, 0.055; III, 0.187; IV, 0.095; V, 0.106; VI,

basal, 0.099; filament, 0.194; total, 0.772 mm.

Oviparous Generation.

Before first molt and less than 24 hours old: General color pea-green. Beak not reaching beyond the coxae of the third pair of legs, apical segment dark. Antenna colorless except last segment which is darker than the remainder. Eyes black. Legs pale, except the tarsi, which are black. Measurements: length of body, 0.954 mm.; width, 0.486 mm.; antenna, I, 0.038; II, 0.038; III, 0.114; IV, 0.153; total, 0.343 mm.

After first molt and 5-6 days old: General color dirty pea-green with very slight tint of red. Last segment of antenna dark. Tarsi black. Measurements: length of body, 1.145 mm.; width, 0.573 mm.

Oviparous female after third molt: Color of head and first thoracic segment very dark green. Remainder of body slate-gray with a reddish tint. The bloom which covers the body gives to the aphid the grayish color. Tips of antennae dark. Tarsi black. Cornicles darker than body color, with a black ring at the base of each. Measurements : length of body, 1.985 mm.; width, 1.050 mm.

Adult wingless oviparous female: General color plumbeous, which is due to the bloom covering the body. Head black and first thoracic segment very dark beneath the bloom. Abdomen tinged with pink. In alcoholic specimens,

from which the bloom has been removed, the markings are ~~as~~ as in the pseudogynes, except that the black markings on the last three abdominal segments are not present. Antennae dark, with one large circular sensorium near the apical end of the fifth segment and several at the apical end of the thickened base of the sixth. Beak reaching beyond the middle coxae. Eyes black. Legs dark; the hind tibiae noticeably swollen and thickly covered with small circular sensoria. Cornicles black and of the same shape as in the pseudogynes. Apical half of style dark. Measurements: length of body, 2.201 mm.; width 1.218 mm.; antenna, I, 0.038; II, 0.047; III, 0.172; IV, 0.076; V, 0.095; VI, basal, 0.100; filament, 0.154; total 0.682 mm.

Male after third molt: Head and first thoracic segment pale green, between pea- and sage-green. Abdomen drab. Measurements: length of body, 1.546 mm.; width, 0.687mm.

Adult wingless male: Head black. Thoracic segments each with a transverse black marking, this giving the thorax a blackish appearance. Similar but shorter markings occur on the first three and the last three abdominal segments. The spots on the sides of the body are arranged in more or less uniform rows. Third antennal segment with twelve or more sensoria irregularly distributed, they being most numerous ~~however~~, near the apex; fourth with 5-7 sensoria; fifth with 2-4 similar sensoria and a larger one near

the apex, and several at apex of the basal part of the sixth. Eyes black. Antennae, legs and cornicles black. Measurements (alcoholic specimens):length of body, 1.636-1.745 mm.; width, 0.909-0.945 mm.; antenna, I, 0.081; II, 0.054; III, 0.200; IV, 0.136; V, 0.100; VI, basal, 0.109; filament, 0.181; total, 0.861 mm.; cornicle, 0.082 mm.

Eggs: Elliptical oval, yellow or greenish when first laid, gradually darkening to a jet black. In spring just before hatching the eggs change from black to pale green. Length, 0.782 mm; width, 0.391 mm.

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1879 Thomas, Cyrus. The maize or corn aphis, *Aphis maidis* Fitch. : Eighth Rept.St.Ent.Ill. for 1878., pp.89-91. Same: Trans.Dept. Agr.St.Ill., vol.16. -Gives characteristics of the root form as presented by Fitch and Walsh, and also a description of specimens which he obtained the previous summer from a different part of the plant (tassels). Also speaks of the damage done by the root form.

*This bibliography is practically complete and contains a number of references not found in the work of Henshaw and Banks.

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1889 Alwood, W. B. The corn plant-louse . The Southern Planter, Aug.,1889,pp.116-117. -Article in response to an inquiry from a farmer in that state(Virginia) who had found the aerial and root forms of the corn plant louse troubling his crops. Gives life-history and suggests remedy by destruction of fodder and stalks and the plowing up of the stubble in the fall and the putting of the field to small grain next year.

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1891 Osborn, H. The corn root aphis. Orange Judd Farmer,Apr.25, 1891.,p.260. -Gives suggestions made by Dr. Forbes as to the methods to be used in diminishing the injury by this aphis.

1891 Pearson, J. Destructiveness of the corn-root plant-louse in Nebraska. Insect Life,vol.4,p.142. -In Nebraska some farmers lost as much as one-third of their crop. He suggests rotation of corn with small grain.

1891 Weed, C. M. Sixth contribution to a knowledge of the life-history of certain little-known Aphididae. Ill.St.Lab.Nat. Hist.,vol.3,art.12. (written Dec.1887) -Aphis maidis? root form. Summary of known life-history. Hatching of lice from eggs in spring. True sexes produced in fall and eggs are laid which are cared for by ants through the winter. Descriptions of wingless male and egg.

-Insects and Insecticides. Hanover, N.H., pp.209-210. -The corn root-aphis (Aphis maidis?). General life-history; gives the rotation of crops as the only known successful remedy.

1891 Williams, T. A. Host plant list of North American Aphididae. Spec.Bull.#1, Univ.Neb., Dept.Ent. -Lists the food plants of Aphis maidis, feeding on roots, as-Dock(Rumex altissimus), Setaria glauca, S.viridis, knot-weed(Polygonum persicaria), plantain(Plantago major), ragweed(Ambrosia trifida), and smartweed(Polygonum sp.).

1892 Bruner, L. Report of Entomologist. Ann.Rept.Neb.St.Bd.Agr. for 1891. pp.300-304., figs. -Aphis maidiradicis Forbes. Gives descriptions of all forms. Quotes the life-history from that given by Professor Forbes.

1892 Riley, C.V. and Howard, L.O. Review of Professor Forbes' Sixth Report. Insect Life, vol.4, nos.9 and 10, p.293. -Mentions that it contains a summary history of the corn root aphis and a colored plate of same.

1892 Webster, F. M. Early published references to some of our injurious insects. Insect Life, vol.4, nos.7 and 8., p.264. -Gives references to the original descriptions of Aphis maidis, root and aerial forms. Gives reference to a note in Amer. Farmer, vol.4, p.71, May 24, 1822, from Mr.Tho.Emory, of Poplar Grove (State not given), relating to a disease of wheat known as "sedging", says, "I believe this insect is the same as that known by the name of the root-louse in corn, so frequently found in that plant," etc.

1892 Riley, C. V. and Howard, L. O. The corn root aphis. Insect

Life,vol.4,nos.7 and 8,Mar.1892. -Short review of Dr. Weed's article on the corn root aphis,published as a bulletin of Ill.St.Lab.Nat.Hist.

1893 Riley, C. V. and Howard, L. O. The corn plant-louse. Insect Life,vol.6,p.32. -Crop of corn in Maryland owned by E. P. Thomas was damaged 50% last year by this louse;also injury this year(June 27,1893).

1894 Forbes, S. A. Eighteenth Report of the State Entomologist of Illinois. Trans.Dept.Agr.Ill. for 1893.,vol.31,pp.57,58-85. Separate :Springfield,Ill. -The corn root aphis,Aphis maidiradicis Forbes:-Injury to corn and to other plants;life-history;relation to the corn leaf aphis;natural enemies; economic procedure;discusses in full (1)rotation, (2)fertilizers and/insecticides, (3)breaking up the ants nests in fall by plowing etc., (4)early spring plowing etc. Descriptions of wingless,winged and pupa of viviparous female,wingless oviparous female,wingless male,and egg. Figures accompany all the descriptions.

1894 Osborn, H. Corn insects,their injuries and how to treat them. Iowa Agr.Exp.Sta.,Bull.24,pp.994-995.,fig. -Mentions Aphis maidiradicis as an important corn insect,although as yet it hardly seemed probable that the species has become very much distributed in Iowa.

1894 Sempers, F. W. Injurious insects and the use of insecticides, p.157. Philadelphia. -Short account of the corn root aphis with remedies. "No artificial remedy is known for this pest. In small garden patches kerosene emulsion might be used for

drenching about the roots, but treatment with this insecticide has not been regarded as practicable on a large scale".

1896 Forbes, S. A. Insects injurious to the seed and root of Indian corn. Ill.Agr.Exp.Sta.,Bull.44,pp.237-257.,figs. -Largely a recapitulation of the account given in the Eighteenth Report of the State Entomologist of Illinois.

1896 Smith, J. B. Economic entomology,p.134. Philadelphia. -Mentions the corn root louse and methods against it.

1896 Hopkins, A. D. and Rumsey, W. E. Practical entomology. W.Va. Agr.Exp.Sta.,Bull.44,p.279. -Very inaccurate account of the life-history of Aphis maidiradicis. It was found to be exceedingly common and destructive to corn in Jackson,W.Va., in May 1891. Remedies are given.

1898 Webster, F. M. Entomology. Ohio Farmer,Sept.1,1898,p.143. - Notes on Aphis maidiradicis.

1900 Lugger, O. Bugs injurious to cultivated plants. Minn.Agr.Exp. Sta.,Bull.69,pp.184-185,fig. -Quotes Osborn in regard to the corn root louse.

1900 Smith, J. B. Insects of New Jersey. Supplement to Twenty-seventh Ann. Rept. State Bd. Agr. N.J. for 1899.,p.104. - Lists Aphis maidis Fitch and speaks of it as often causing serious injury to the young plants by their attacts on the roots.

1901 Bruner, L. Corn root insects. Nebraska Farmer,Feb.14,1901, figs. -General account of the life-history of the corn root louse with suggested remedies.

1901 Hunter, W. D. The Aphididae of North America. Iowa Agr.Exp. Sta.,Bull.60,pp.98-99. -Lists *Aphis maidiradicis* from Iowa; gives other states in which it is found;food plants;and bibliography of literature.

1901 Sanderson, E. D. The corn root-louse. Twelfth Ann.Rept.Del. Agr.Exp.Sta. for 1900.,p.211. -Sweet and sugar corn worse affected than field corn. Lice common on weeds early in the season and were found on squash roots in June.

1902 Sanderson, E. D. Insects injurious to staple crops,pp.134-141, figs. New York. -The corn root louse. *Aphis maidiradicis* Forbes. A general description of the aphis;distribution;food habits;life-history;care by ants;remedies.

1902 Washburn, F. L. Insects notably injurious in 1902. Seventh Ann.Rept.St.Ent.Minn.,p.64,fig. Also as Bull.77,Minn.Agr.Exp. Sta.,Nov.1902. -Brief notes on *Aphis maidis Fitch* (root and aerial formes) as occurring in Minnesota;remedies.

1904 Stedman, J. M. Common corn insects. Mo.St.Bd.Agr.,Bull.3,No. 11,pp.11-17. -Notes on the corn root aphis in Missouri.

1905 Forbes, S. A. Field experiments and observations on insects injurious to corn. Ill.Agr.Exp.Sta.,Bull.104,pp.102-123. -Discusses experiments made in 1904-1905 to control the corn root-louse by means of treatment of the soil before planting. Also gives additional notes on the life-history.

-Injurious insects of corn. A conference on the corn insects of Illinois,at the Tenth Ann. Meeting of the Ill. Farmers Inst.,Joliet,Ill.,Feb.21,1905. Also in Rept. Ill. Farmers Inst.,vol.10,pp.35-45. -Gives account of the

corn root aphis and experiments made in the past year. Questions and answers. One colored plate of the corn root-louse and the root-louse ant.

-The principal insects injurious to the corn plant. Rept.Ill. Farmers Inst.,vol.10,pp.240-251,figs. -Injury to corn and to other plants;life-history;relation to ants;and economic proceedure.

1905 Kohler, A. R. Insects injurious to corn. Iowa Agriculturist, vol.6,no.3,pp.84-85. -Short account of the corn root-louse.

1905 Pettit, R. H. Insects of the garden. Mich.Agr.Exp.Sta.,Bull. ,p.53. Also in Ninteenth Ann.Rept.Mich.Agr.Exp.Sta.,1906, p.204. -Mentions *Aphis maidiradicis* as a corn insect but that thus far it has not been observed in Michigan.

1905 Symons, T. B. Common injurious and beneficial insects in Maryland. Md.Agr.Exp.Sta.,Bull.101,pp.160-161. -The corn root aphis. Short notes and remedies.

1906 Davis, J. J. The corn root-louse. *Aphis maidiradicis* Forbes. Ill. Agriculturist,vol.10,March,pp.213-218.,6 figs. Abstract :Wallaces Farmer,vol.31,May 11,1906,p.637. -General account of habits,life-history,etc.,and remedies.

1906 Forbes, S. A. The corn root-aphis and its attendant ant. U.S. Dept.Agr.,Bur.Ent.,Bull.60,pp.29-41. -A complete account of the corn root-aphis. Discusses:economic importance;life-history;the attendant ant;relation of ant and aphis;injury to corn;natural checks on increase;practical economic measures;and a preventive routine.

1906 Kirkaldy, G. W. Catalogue of the hemipterous family Aphidae, with their typical species, together with a list of the species described as new from 1885 to 1895. Can. Ent., vol.38, p.13. -Lists *Aphis maidiradicis* Forbes.

1906 Sanborn, C. E. Kansas Aphididae, with Catalogue of N. American Aphididae, and with Host-Plant and Plant-Host list. Part 2. Kansas Univ.Sci.Bull., vol.3, no.8, p.258. -Lists food plants of *Aphis maidiradicis* Forbes as *Amarantus hybridus*, *Erigeron canadensia*, *Oxalis stricta*, *Plantago major*, *Portulaca oleracea*, *Rumex crispus*, *Setaria italica germanica ochloa*, and corn.

1907 Forbes, S. A. The corn root-louse. Fayette County Democrat, vol.47, no.19, Mar.6, 1907 :Bureau County Record, Mar.6. :The Weekly Pantograph, vol.90, no.12, Mar.22. Also in many other Illinois newspapers. -Gives detailed accounts of the new oil of lemon treatment which he has found to be the most affective method of controling the corn root-aphis.

1907 Stout, J. P. Control of the corn root aphis. Ill. Agriculturist, Apr., pp.245-247, figs. -Gives methods which have been successfully used to combat the corn root aphis, including the oil of lemon treatment, which Dr. Forbes has proven to be the most practical method of controling this root louse.

1907 Webster, F. M. The corn leaf-aphis and corn root-aphis. U.S. Dept.Agr., Bur.Ent., Cir.86, May 6, 1907. -Gives general description and discusses: root aphis and the little brown ant; life-history and habits; natural enemies; and preventive and remedial measures.

15 „	22 „	23 „	8 „	6 Oct	14 „	0 „	32	2.2+	5	6 Oct.	22 „
16 „	22 „	22 „	6 „	7 „	16 „	6 „	23	1.4+	4	13 „	28 „
17 „	25 „	25 „	8 „	15 „	20 „	6 „	28	1.5	4	22 „	34 „
18 „	24 „	25 „	7 „	8 „	14 „	2 „	25	1.7+	4	10 „	23 „
19 „	25 „	26 „	7 „	8 „	13 „	3 „	20	1.5+	5	11 „	23 „
19 „	26 „	27 „	8 „	17 „	20 „	7 „	56	2.8	7	27 „	35 „
20 „	27 „	27 „	7 „	15 „	18 „	1 „	52	2.8+	5	16 „	26 „
22 „	1 Oct.	2 Oct.	10 „	22 „	20 „	18 „	29	1.4+	4	7 Nov.	48 „
22 „	30 Sept.	1 Oct.	9 „	17 „	16 „	3 „	21	1.3+	7	21 Oct.	28 „
22 „	29 „	1 „	9 „	2 Nov.	32 „	1 „	35	1.+	4	3 Nov.	42 „
27 „	7 Oct.	9 „	12 „	31 Oct.	22 „	8 „	26	1.1+	4	9 „	42 „
30 „	13 „	14 „	14 „	2 Nov.	18 „	5 „	29	1.6+	4	7 „	36 „
26 „	5 „	6 „	10 „	24 Oct.	14 „	3 „	21	1.5	3	27 Oct.	27 „
2 Oct.	15 „	17 „	15 „	29 „	12 „	x „	29	2.4+	8	x „	27 „
2 „	13 „	15 „	13 „	24 „	9 „	2 „	22	2.4+	4	26 „	24 „
2 „	14 „	15 „	13 „	24 „	9 „	0 „	23	2.5+	5	24 „	22 „
3 „	16 „	17 „	14 „	26 Nov.	40 „	2 „	49	1.2+	3	28 Nov.	56 „
Total			1044		1367		5651	570.82			2573
Average			8.1+		10.6+		44.1+	4.4+			20.1+

Table I

Aphis maidiradicis Forbes

Data of individual experiments viviparous generation 1906.

Date of birth	Date she became adult	Date of first young	Period between birth and first young	Date of last young	Period between first and last young	Life after last young	Number of young	Average number of young per day during reproductive period	Largest number of young in one day	Date of death	Total age
18 Apr	30 Apr	1 May	13 days	8 May	17 days	2 days	96	5.6+	0	20 May	32 days
19	2 May	4	15	14	10	1	36	3.6	0	15	26
1 May	12	13	12	27	14	6	74	5.3	0	2 June	32
4	15	16	12	4 June	19	5	64	3.4	8	9	36
13	19	21	8	30 May	9	1	53	5.9+	9	31 May	18
14	23	24	10	1 June	8	1	33	4.1+	7	2 June	19
16	23	24	8	2	9	0	50	5.5+	8	2	17
16		26	8	4	9	0	42	4.6+		4	19
21	27	29	8	4	6	0	31	5.3+		6	17
24		2 June	9	15	13	0	58	[illegible]		15	22
24	1 June	2	9	9	7	1	41	5.8	7	10	17
26	4	4	9	9	5	0	33	6.6	8	9	14
29	5	6	8	24	18	8	89	4.9+	9	2 July	34
31		8	8	19	11	0	34	3+	7	19 June	19
2 June	8	9	7	17	8	1	40	5.	8	18	16
3	9	10	7	16	6	2	24	4	5	18	15
4	12	14	10	29	15	2	73	4.8+	10	1 July	27
6	14	15	9	2 July	17	9	76	4.4+	7	11	35
8	17	18	10	2	14	0	62	4.4+	9	2	24
9	17	18	9	29 June	11	0	58	5.3	8	29 June	20
10		18	8	29	11	2	51	4.6+	7	1 July	21
10	19	20	10	1 July	11	3	48	4.3+	7	4 July	24
10	18	19	9	30 June	11	2	72	6.5	11	2	22
14	21	22	8	30	8	0	53	6.6+	10	30 June	16
6	16	18	12	25	7	0	21	3	6	25	19
18	27	27	9	4 July	7	3	37	5.2+	8	7 July	19
18	26	27	9	8	11	0	65	5.9+	8	8	20
18		26	8	2	6	1	45	7+	9	3	15
18	25	26	8	1	5	0	29	5.8	10	1	13
19	26	28	9	13	15	0	44	3	8	13	24
19	26	27	8	5	8	1	51	6.3+	10	6	17
20		28	8	8	10	1	50	5.	8	9	19
22	29	30	8	11	11	0	62	5.6+	8	11	19
23		30	7	15	15	0	74	4.9+	7	15	22
27		4 July	7	10	6	0	29	4.8+	8	10	13
27	3 July	4	7	13	9	0	38	4.2+	8	13	13
27	2	3	6	16	13	0	59	4.5+	9	13	19
28	6	6	8	15	9	1	48	5.3+	7	16	18
30	7	8	8	11	3	0	22	7.3+	7	11	11
3 July	10	11	8	20	9	0	44	4.9+	7	20	17
4	11	12	8	20	8	1	42	5.2+	8	21	17
6	12	13	7	24	11	1	52	4.7+	7	25	19
8	13	14	6	27	13	10	64	4.9+	8	6 Aug	29
8	14	15	7	23	8	0	53	6.6+	7	23 July	15
8	14	14	6	25	11	0	56	5+	9	25	17
11	17	18	7	24	7	1	49	7	10	25	14
11	18	19	8	31	12	0	66	5.5	8	31	20
12	18	19	7	28	9	0	54	6.	8	28	16
13	21	21	7	29	8	1	44	5.5	7	30	16
13	18	19	6	29	10	2	45	4.5	7	31	18
14	21	21	7	27	6	0	25	4.1+	8	27	13
14	21	22	8	1 Aug	10	0	62	6.2	10	1 Aug	18
18	23	24	6	29 July	5	0	29	5.8	8	29 July	11
19	25	26	7	10 Aug	15	3	70	4.7	8	13 Aug	25
19	25	26	7	4	9	1	55	6.1+	7	5	17
19	25	26	7	5	10	0	51	5.1	7	5	17
21	28	28	7	6	9	2	47	5.2+	8	8	18
21	28	29	8	3	5	0	30	6	9	3	13
22	28	29	7	6	8	0	46	5.7+	8	6	15
22	29	30	8	8	9	1	51	5.1	8	9	17
26	1 Aug	2 Aug	7	10	9	1	46	5.1+	8	11	16
26	1	2	7	8	7	0	49	7.	8	8	14
26	1	2	7	9	8	0	43	5.3+	9	9	15
27	2	2	6	9	8	0	46	5.7+	10	9	14
28		5	8	14	9	0	46	5.1+	6	14	17
29	4	5	7	11	6	1	35	5.8+	8	12	14
30	5	5	6	9	5	0	24	4.8	6	9	10
29	4	5	7	18	13	0	55	4.2+	9	18	20
1 Aug	7	7	6	13	6	1	37	6+	8	14	13
2	8	9	7	21	14	1	63	4.5	6	22	22
2	7	8	6	15	7	0	45	6.4+	9	15	13
5	13	13	8	22	9	0	44	4.8+	8	22	17
5	12	13	8	19	7	0	31	4.4+	5	19	14
5	11	12	7	22	10	0	54	5.4	8	22	17
5	11	12	7	18	6	1	35	5.8+	8	19	14
7	15	15	8	26	11	0	50	4.5+	9	26	19
9	15	16	7	24	8	0	41	5.1+	8	24	15
9	15	16	7	27	12	0	58	[illegible]	8	27	19
9	17	17	8	23	6	0	31	5.1+	7	23	14
12	19	19	7	29	10	0	48	4.8	7	29	17
13	19	20	7	29	9	0	60	6.6+	9	29	16
12	18	19	7	24	6	0	33	5.5	8	24	12
15	21	22	7	2 Sept	11	0	51	4.6+	9	2 Sept	18
16	22	23	7	2	10	0	56	5.6	7	2	17
17	23	23	6	2	10	0	47	4.7	[illegible]	2	16
17	23	23	7	3	11	0	49	4.4+	6	3	18
19	26	26	7	5	10	0	47	4.7	7	5	17
19	26	27	8	15	19	0	48	2.5+	8	15	27
19		27	8	9	14	0	66	4.7+	10	9	22
20	25	26	6	3	8	0	42	6.	7	3	14
22	29	30	8	8	9		50	5.5+	6	9	18
22	29	30	8	7	9	1	42	4.6+	7	8	18
23	31	31	8	10	10	2	51	5.1	7	12	20
23	31	31	8	6	7	2	34	4.8+	7	8	17
23		2 Sept	10	15	13	1	56	4.2+	7	16	24
24		2	9	8	6	0	27	4.5	6	8	15
26		2	7	10	8	0	40	5.	8	10	15
28	4 Sept	4	7	9	5	0	24	4.8	5	9	12
30	7	7	8	12	5	0	22	4.4	7	12	13
30	6	7	8	23	16	0	40	2.4	5	23	24
31	7	8	8	19	11	0	23	2+	6	19	19
31	8	9	9	21	12	0	23	2	5	21	21
2 Sept	10	11	9	16	5	0	23	4.6	5	16	14
2	10	11	9	17	6	1	33	5.5	7	18	16
4	11	11	7	28	17	2	49	2.8+	[illegible]	30	26
4	11	11	7	19	8	1	37	4.6+	[illegible]	20	16
5		12	7	20	9	1	28	3+	6	21	17
7	14	15	8	25	10	0	41	4.1	7	25	18
11	18	19	8	26	7	0	35	5	9	26	15
11	18	19	8	24	6	0	30	5	9	24	14
13	19	20	7	27	8	1	41	5+	9	28	16
15	22	23	8	6 Oct	14	0	32	2.2+	5	[illegible] Oct	22
15	22	22	6	7	16	6	23	1.4+	4	13	28
17	25	25	8	15	20	6	28	1.5	4	22	34
19	24	25	7	8	14	2	25	1.7+	4	10	23
[illegible]	25	26	7	8	13	3	20	1.5+	5	11	23
19	26	27	8	17	20	7	56	2.8	7	27	35
20	27	27	7	15	18	1	52	2.8+	5	16	26
22	1 Oct	2 Oct	10	22	20	18	29	1.4+	4	7 Nov	48
22	30 Sept	Oct	9	17	16	3	21	1.3+	7	21 Oct	28
22	29	1	9	2 Nov	32	1	35	1+	4	3 Nov	42
27	7 Oct	9	12	31 Oct	22	8	26	1.1+	4	9	42
30	13	14	14	2 Nov	18	5	29	1.6+	4	7	36
26	5	6	10	24 Oct	14	3	21	1.5	3	27 Oct	27
2 Oct	15	17	15	29	12	×	29	2.4+	8	×	27
2	13	15	13	24	9	2	22	2.4+	4	26	24
2	14	15	13	24	9	0	23	2.5+	5	24	22
3	16	17	14	26 Nov	40	2	49	1.2+	3	28 Nov	56
Total			1044		1367		5651	570.82			2575
Average			8.1+		10.6+		44.1+	4.4+			20.1+

Aphis maidiradicis Forbes.

Table II.

Line of generations. from egg to oviparous generation. 1906.

Generation	Date of birth.	Date it became adult.	Date of first young	Period between birth and its first young.	Date of last young	Period between first and last young.	Life after last young.	Number of young.	Average number of young per day, during birth-giving period	Largest number of young in one day.	Date of death or disappearance	Total length of life.
1 from egg	18 Apr.	30 Apr.	1 May	13 days	18 May	17 days	2 days	96	5.6	10	20 May	32 days.
2	1 May	12 May	13 ..	12 ..	27 ..	14 ..	6 ..	74	5.3	10	2 June	32 ..
3	13 ..	19 ..	21 ..	8 ..	30 ..	9 ..	1 ..	53	6.6	9	31 May	18 ..
4	21 ..	27 ..	29 ..	8 ..	4 June	6 ..	0 ..	31	5.3	7	6 June	14 ..
5	29 ..	5 June	6 June	8 ..	24 ..	18 ..	8 ..	89	4.9	9	2 July	34 ..
6	6 June	14 ..	15 ..	9 ..	2 July	17 ..	9 ..	76	4.4	7	11 ..	35 ..
7	15 ..	22 ..	23 ..	8 ..	25 ..	2 ..	0 ..	7	3.5	4	25 June	10 ..
8	23 ..		30 ..	7 ..	15 ..	15 ..	0 ..	74	4.9	7	15 July	22 ..
9	30 ..	7 July	8 July	8 ..	11 ..	3 ..	0 ..	22	7.3	7	11 ..	11 ..
10	8 July	14 ..	15 ..	7 ..	23 ..	8 ..	0 ..	53	6.6	7	23 ..	15 ..
11	15 ..	22 ..	22 ..	7 ..	24 ..	2 ..	0 ..	7	3.5		24 ..	9 ..
12	22 ..	29 ..	30 ..	8 ..	8 Aug.	9 ..	1 ..	51	5.1	8	9 Aug	17 ..
13	30 ..	5 Aug.	5 Aug	6 ..	9 ..	5 ..	0 ..	24	4.8	6	9 ..	15 ..
14	5 Aug.	12 ..	12 ..	7 ..	16 ..	4 ..	0 ..	17	4.2	6	16 ..	11 ..
15	12 ..	18 ..	19 ..	7 ..	24 ..	6 ..	0 ..	33	5.5	8	24 ..	13 ..
16	19 ..		27 ..	8 ..	9 Sept.	14 ..	0 ..	66	4.7	10.	9 Sept	22 ..
17	28 ..		5 Sept.	8 ..	8 ..	3 ..	0 ..	13	4+	6	8 ..	11 ..
18	5 Sept.		12 ..	7 ..	20 ..	9 ..	1 ..	28	3+	6	21 ..	17 ..
19	13 ..	19 Sept.	20 ..	7 ..	27 ..	8 ..	1 ..	41	5+	9	28 ..	16 ..
20	21 ..	28 ..	30 ..	9 ..	2 Oct.	3 ..	0 ..	10	3+	4	2 Oct	12 ..
21	30 ..	13 Oct.	14 Oct	14 ..	2 Nov.	19 ..	5 ..	29	1.5		7 Nov.	38 ..
22	14 Oct.	27 ..	Oviparous generation.								22-23 ..	39 ..

Aphis maidiradicis Forbes.

Table III.

Periods and Succession of Generations. 1906.

Generation.	April	May	June	July	August	September	October	November	December	Length of generations.
1	18	20								32 days
2		1	4							34 „
3		13	18							36 „
4		21		2						41 „
5		29		14						46 „
6			6	31						45 „
7			15		18					64 „
8			23			3				72 „
9			30			15				77 „
10				8			13			97 „
11				15				3		111 „
12				22			24			94 „
13				30				9-12		102 or 105 „
14					5			26		113 „
15					12				19	129 „
16					19			19		92 „
17					28			21		85 „
18						5		23		79 „
19						12		28		77 „
20						20			21	92 „
21						30			1	62 „
22							14		15	62 „

Aphis maidiradicis Forbes.

Table IV.

Line of generations.- from egg to oviparous generation. 1906.

Generation	Date of birth	Date of becomming adult.	Date of first young	Period between birth and her ~~first~~ first young.	Date of last young	Period between first and last young.	Life after last young	Number of young.	Average number of young per day during birth-giving period.	Largest number of young in one day	Date of death or disappearance	Total length of life.
1 from egg.	19 Apr.	2 May	4 May	15 days	14 May	10 days	1 day	36	3.6	6	15 May	26 days
2	4 May	15 "	16 "	12 "	4 June	19 "	5 "	64	3.4-	8	9 June	36 "
3	16 "	23 "	24 "	8 "	2 "	9 "	0 "	50	5.5+	8	2 "	17 "
4	24 "	1 June	2 June	9 "	9 "	7 "	1 "	41	5.8-	7	10 "	17 "
5	2 June	8 "	9 "	7 "	17 "	8 "	1 "	40	5.	8	18 "	16 "
6	9 "	17 "	18 "	9 "	29 "	11 "	0 "	58	5.2+	8	29 "	20 "
7	18 "	26 "	27 "	9 "	8 July	11 "	0 "	65	5.9+	8	8 July	20 "
8	27 "	3 July	4 July	7 "	13 "	9 "	0 "	38	4.2+	5	13 "	13 "
9	4 July	11 "	11 "	7 "	14 "	3 "	0 "	12	4.	6	14 "	11 "
10	11 "	18 "	19 "	8 "	31 "	12 "	0 "	66	3.3	8	31 "	20 "
11	19 "	25 "	26 "	7 "	10 Aug.	15 "	3 "	70	4.7-	8	13 Aug.	25 "
12	26 "	1 Aug	2 Aug.	7 "	10 "	9 "	1 "	46	5.1+	8	11 "	16 "
13	2 Aug.	8 "	9 "	7 "	21 "	14 "	1 "	63	4.5	6	22 "	22 "
14	9 "	15 "	16 "	7 "	27 "	12 "	0 "	58	3.+	8	27 "	19 "
15	16 "		22 "	6 "	24 "	3 "	0 "	13	4.+	6	24 "	9 "
16	22 "	29 "	30 "	8 "	7 Sept.	9 "	1 "	42	4.6+	7	8 Sept.	18 "
17	30 "	6 Sept.	7 Sept.	8 "	23 "	17 "	0 "	40	2.+	5	23 "	25 "
18	7 Sept.	13 "	14 "	7 "	21 "	8 "	2 "	13	1.+	5	23 "	17 "
19	14 "	21 "	22 "	8 "	23 "	2 "	0 "	4	2.	2	23 "	10 "
20	22 "	1 Oct.	2 Oct.	10 "	22 Oct.	13 "	16 "	29	2.+	4	7 Nov.	39 "
21	2 Oct.	15 "	17 "	15 "	29 "	15 "	X "	29	1.-	8	X	not less than 30 days.
22	17 "	24 Oct. (1) ovip ♀ 5 Nov (2) ♂	Oviparous generation.				These aphids were removed to other cages when they became adult.					

Aphis maidiradicis Forbes.

Table V

Periods and Succession of Generations. 1906.

Generation	April	May	June	July	August	September	October	November	December	Length of generation.
1	12	15								26 days
2		4	9							36 „
3		16	19							34 „
4		24		12						49 „
5			2	28						56 „
6			9		9					61 „
7			18		24					67 „
8			27			8				73 „
9				4		24				82 „
10				12		29				79 „
11				19			26			99 „
12				26				19		116 „
13					2			30		120 „
14					9		discontinued.			
15					16		discontinued.			
16					22		discontinued.			
17					29		discontinued.			
18						7	discontinued.			
19						14	discontinued.			
20						22			7	46
21							2 29			27
22							17	22		36

Aphis maidiradicis Forbes.

Table VI

Periods of molts. - viviparous generation. 1906.

Date of birth	Date of first molt.	Number of days	Date of second molt.	Number of days.	Date of third molt.	Number of days	Date of fourth molt.	Number of days	Period from birth to fourth molt	Date of its first young.	Period from birth to motherhood.
18 Apr.	22 Apr.	4	26 Apr.	4	28 Apr.	2	30 Apr.	2	12 days	1 May	13 days
19 Apr.	24 Apr.	5	27 Apr.	3	29 Apr.	2	2 May	3	13 "	4 May	15 "
1 May	3 May	2	5 May	2	8 May	3	12 May	4	11 "	13 May	12 "
4 May	7 May	3	10 May	3	12 May	2	15 May	3	11 "	16 May	12 "
13 May	15 May	2	16 May	1	17 May	1	19 May	2	6 "	21 May	8 "
21 May	23 May	2	24 May	1	25 May	1	27 May	2	6 "	29 May	8 "
27 June	28 June	1	29 June	1	1 July	2	3 July	2	6 "	4 July	7 "
28 June	29 June	1	1 July	2	4 July	3	6 July	2	8 "	6 July	8 "

Table VII.

Data of individual experiments.– oviparous generation.– 1906.

Date of birth	Date of maturity.	Period of immature stages.	Date of death	Period of life.	Number of eggs laid, if recorded.	Number of eggs found in body, at death if recorded	Total number of eggs.	Sex.
6 Oct.	21 Oct.	15 days	5 Nov.	30 days	10	1	11	♀
6 „	22 „	16 „	5 „	30 „				♂
8 „	24 „	16 „	14 „	37 „	4	2	6	♀
8 „	24 „	16 „	10 „	33 „				♂
9 „	22 „	13 „	26 Oct.*	17 „				♀
9 „	22 „	13 „	2 Nov.*	24 „				♀
15 „	31 „	16 „	28 „	44 „	7	2	9	♀
7 „	20 „	13 „	22 Oct.	15 „				♀
15 „	3 Nov.	19 „	23 Nov.*	39 „				♂
17 „	5 „	19 „	8 „	22 „				♂
15 „	31 Oct.	16 „	31 Oct.*	16 „				♂
15 „	31 „	16 „	2 Nov.*	18 „				♂
15 „	1 Nov.	17 „	9 „ *	25 „				♂
13 „	27 Oct.	14 „	12 „	30 „				♂
29 „	24 Nov.	26 „	11 Dec.	43 „				♀
15 „	29 Oct.	14 „	15 Nov.	31 „	3	2	5	♀
22 „	11 Nov.	20 „	26 „	35 „				♂
13 „	23 Oct.	10 „	29 Oct.*	16 „				♀
13 „	23 „	10 „	29 „ *	16 „				♀
20 „	7 Nov.	18 „	12 Nov.	23 „				♂
19 „	29 Oct.	10 „	2 „ *	X „				♀
20 „	1-2 Nov.	12-13 „	2 „ *	X „				♀
21 „	1-2 „	12-13 „	2 Nov.*	X				♀
26 „	17 „	22 „	1 Dec.	36 „				♂
26 „	4 Dec	39 „	15 „	50 „				♀
24 „	7 Nov.	14 „	30 Nov.	37 „				♀
21 „	8-9 „	18-19 „	14 „ *	24 „				♀
21 „	8-9 „	18-19 „	14 „ *	24 „				♀
24 „	10-11 „	17-18 „	14 „ *	21 „				♀
24 „	16-17 „	23-24 „	5 Dec.	43 „				♀
2 Nov.	21 „	19 „	5 „	33 „				♀
2 „	21 „	19 „	19 „	47 „				♀
6 Oct.	20 Oct.	14 „	25 Oct.*	19 „				♀
6 „	20 „	14 „	26 „ *	20 „				♀
6 „	20 „	14 „	27 „ *	21 „				♀
6 „	20 „	14 „	27 „ *	21 „				♀
7 „	20 „	13 „	21 Nov.	43 „				♀
9 „	21 „	12 „	28 Oct.*	19 „				♀
9 „	21 „	12 „	12 Nov.	34 „	3	8	11	♀
9 „	24 „	15 „	29 Oct.*	20 „				♀
9 „	24 „	15 „	29 „ *	20 „				♀
9 „	24 „	15 „	29 „ *	20 „				♀
9 „	24 „	15 „	31 „	22 „				♀
9 „	24 „	15 „	3 Nov.*	25 „				♀
9 „	24 „	15 „	3 „ *	25 „				♀
12 „	24 „	12 „	23 „	42 „	4	6	10	♀
16 „	31 „	15 „	23 „	38 „	3	5	8	♀
18 „	3-4 Nov.	16-17 „	1 Dec.	44 „	2	5	7	♀

* Removed.

Table VIII

Periods of molts. – Oviparous generation. 1906.

Date of birth.	Date of first molt	Number of days.	Date of second molt.	Number of days.	Date of third molt.	Number of days.	Date of fourth molt.	Number of days.	Period from birth to adult.	Sex.
11 Oct.	14 Oct.	3	16 Oct.	2	20 Oct.	4	24 Oct.	4	13 days.	♀
11 ..	14 ..	3	16 ..	2	20 ..	4	24 ..	4	13 ..	♀
11 ..	14 ..	3	16 ..	2	20 ..	4	25 ..	5	14 ..	♀
16 ..	20 ..	4	22 ..	2	27 ..	5	5 Nov.	9	20 ..	♀
17 ..	19 ..	2	22 ..	3	26 ..	4	30 Oct.	4	13 ..	♀
17 ..	20 ..	3	23 ..	3	27 ..	4	7 Nov.	11	21 ..	♂
21 ..	25 ..	4	30 ..	5	4 Nov.	5	11 ..	7	21 ..	♂
21 ..	24 ..	3	29 ..	5	4 Nov.	6	13 ..	9	23 ..	♂
22 ..	27 ..	5	31 ..	4	4 Nov.	4	7 ..	3	16 ..	♀

Aphis maidis Fitch.

The corn leaf-aphis was first found injuring corn by Dr. Asa Fitch, and in his Second Report of the Insects of New York (1856) he gives an account of its injuries to corn, describes it, and proposes for it the name of Aphis maidis. Although since that time considerable work has been done on this aphis, we are still in ignorance as to how it spends the winter. In 1862 Mr. Benj. Walsh found an aphis living on the roots of corn and, although he was doubtful as to its identity, he distinguished it by calling it the root form of Aphis maidis. From that time until 1891 these two forms were supposed to be the same species until Dr. Forbes, who had, since his first knowledge of them, regarded them as two distinct species, named the subterranean form Aphis maidiradicis in the Seventeenth Report of the State Entomologist of Illinois.

It has always been considered more or less of a pest to corn, sorghum, and broom-corn, although it seldom becomes seriously injurious. In some cases, however, it does injure the corn ears by sucking the sap from the silk and killing them, thus preventing fertilization of the kernels. Only rarely, however, does it stunt the growth of a plant, at least in Illinois, the reason probably being that in this state the aphis does not commence its attacks upon the plant until the last part of June or the first of July, at which time the plant is strong enough to withstand the drain made upon its sap supply by the aphis. This aphis sometimes does considerable injury to the quality of the brush of broom-corn by discoloring it, the discoloration being "due to a bacterial affection

✓ following upon the plant-louse punctures." (Forbes).

This aphid has a very wide distribution, being found in all parts of the United States where corn is grown, i.e., from Maine to Texas and from Michigan to California. Professor F. M. Webster has reported finding it on sorghum in Australia, where, he says, it is sometimes quite obnoxious. Also, in a recent circular, Professor Webster says that "the insect is also known from Japan."

Though the usual food plants are corn, sorghum, and broom-corn, this species feeds also on various other plants, namely, barley, Setaria glauca, and Oxalis. At Urbana, Ill., September 7, 1906, in an infested corn field, I found Aphis maidis also breeding on foxtail (Chaetochloa glauca), Echin~~a~~ochloa crus-galli, and Panicum sanguinalis.

In our insectary, in 1906, plants of Echin~~a~~ochloa (Panicum) crus-galli, and Synthe~~n~~ris~~in~~ma (Panicum) sanguinalis, which ha~~s~~d accidentally grown up in some unused pots, became almost covered with Aphis maidis. Numbers of these aphids were placed in a Comstock cage containing the common weeds found around corn fields, namely, Chaetochloa (Setaria) glauca, Echin~~a~~ochloa (Panicum) crus-galli, Polygonum pennsylvanicum, Panicum proliferum, Synthensina (Panicum) sanguinalis, broom-corn, sorghum, and corn. When examined two days later (September 10, 1906) the aphids were breeding freely on all plants except corn, which was at that time just sprouting. November 4, aphids were on all plants except Echin~~a~~ochloa crus-galli, Polygonum pennsylvanicum, and Panicum proliferum, which plants were then dead. December 9, there were a few on the sorghum and corn, these being the only plants alive at that time. When examined about a week later all plants in the cage were dead and no aphids

could be found. It might be mentioned that this cage was kept at the outdoor temperature. This aphid shows a decided preference for broom-corn over ~~other~~ Indian corn and sorghum. Both in the field and in the insectary, aphids which had been living on sorghum plants for a number of generations always changed to broom-corn plants when these were placed in the cages.

As stated before, we do not know where and how this aphid survives the winter. In Illinois it first appears in midsummer, the earliest date being June 26, 1906, at which time Mr. E. O. G. Kelly found them qhite numerous on broom-corn at Mattoon, Ill. We know that they reproduce parthenogenetically from the time of their first appearance in the fields until their disappearance in the fall. In the fall they gradually die off as freezing weather comes, leaving neither eggs nor hibernating adults around the corn plants. Numerous experiments have been made by Dr. Forbes and his assistants to determine the manner in which this species hibernates, and whether or not there is a sexual generation in the fall, as is usually the case with aphids. Since these investigations were thorough, it seems quite probable that they do not spend the winter in the egg stage in the northern part of Illinois. There is one possible explanation as to its winter history which may explain the fruitlessness of the attempts at obtaining the winter history, and that is that it may hibernate as an adult in the warmer states or even in southern Illinois, and as the summer progresses migrate to the north and gradually infest the plants in these northern states. There are several facts in favor of this theory; for one thing, this species has been found in Mississippi on barley in January. Other facts point against this theory; thus, so far as we know,

aphids are unable to travel great distances. No work has been done as yet on this line of investigation, and it is possible that if one began his search for this louse in the southern parts of Illinois he would find it at a much earlier date than it has heretofore been reported, and that he could follow its gradual migration northward.

I have worked out in the insectary (1906) the summer history as regards the number of generations, rate of multiplication, number of young, etc. Aphis maidis was collected by Mr. Kelly June 26 and the specimens sent in by him were reared on sorghum and broomcorn plants. From that date until killed by the cold weather in fall a maximum of 17 generations was obtained. Although no exact figures can be given as to the minimum number of generations (breeding always from the last born of each generation), still, from my experiments, it can be definitely stated that there were not more than 9 generations after June 26. The aphids were kept in the unheated insectary greenhouse, and thus the temperature was approximately the same as that out-of-doors. The last date recorded for living aphids was December 21. I did not make any observations in the field in 1906, but in 1905 (a more severe season than 1906) I found living Aphis maidis on sorghum as late as October 28, and all found at that date were either winged or else pupae of winged viviparous females. The immature stage varied from 5 to 24 days, varying with the season; thus, in the warmer parts of the year, from the last of June until the middle of September, the average for 30 experiments was 6.6 days; while from the middle of September until the first of November, for 10 experiments the average was 12.8 days. The average for the entire 40 experiments was 8.1+

days. The length of the period for producing young varied up to 48 days, with an average, for the entire series of experiments, of 19 days. The mother usually lived a few days after the birth of her last young. The entire length of life averaged 31.6+ days. The average number of young produced by a single aphid, in the 33 experiments of which record was kept, was 33.5+, while the largest number was 65. Individual aphids produced as many as 6 or 8 young per day in some cases, but the usual number was 2. The number of molts is invariably four. The accompanying table gives the records of a few individuals, showing the number of molts and the time between each molt.

Descriptions.

Aphis maidis Fitch. Viviparous Generation.

Before first molt and less than one hour old: General color light pea-green. Eyes red. Antennae transparent, only four distinct segments, or five if the filament be counted, the third having a slight constriction which is the beginning of a division of that segment. Legs transparent. Cornicles vasiform. Measurements: length of body, 0.545 mm.; width, 0.236 mm.

After first molt and 24--48 hours old: General color between pea- and chromium-green. Eyes red. Antennae as in the earlier stages, but not transparent, while the constriction of the third segment is more distinct, and there is a sensorium at the apical end of the third segment. Fore part of head darker than body color. Legs paler than body color except parts of the femur and tarsus, which are darker; the tip of the abdomen also is darker. Cornicles longer and more distinct than before first molt. Measurements: length of body, 0.927 mm.; width, 0.363 mm.; antennae, 0.325 mm.

After second molt and 48--72 hours old: General color chromium-green, the sides being slightly darker. Head and first thoracic segment bottle-green. Eyes dark red. Antennae pale green, with black tips. What was spoken of in the earlier stages as the third segment is now divided into two distinct segments, otherwise, except as to size, the antennae are the

same as in the earlier stages. Tips of legs black. Tip of abdomen dark chromium-green. The black cornicles are surrounded at their bases by dark green patches. Measurements: length of body, 1.090 mm.; width, 0.454 mm.; antenna~~e~~, 0.342 mm.

After third molt and 96--120 hours old: General color chromium-green. Head and first thoracic segment darker green. Eyes dark red. First and last segments of the antennae black. As yet only five distinct segments, or six, if the filament be counted. Tarsi black; femora of the posterior pairs of legs partly black. Tip of abdomen dark green; and penultimate segment with a stripe of dark green nearly covering the entire segment. Cornicles black, with dark green basal spots. Measurements: length of body, 1.254 mm.; width, 0.527 mm.; antenna~~e~~, I., 0.044; II., 0.037; III., 0.132; IV., 0.061; V., basal, 0.057; filament, 0.117; total, 0.448 mm.

Adult wingless female.--Head black. Antennae black, excepting third segment. Eyes very dark reddish brown. Beak dark, its apex black shading to brown. General color of body bice-green. Fore segments and tip of abdomen very dark green. Legs black, excepting middle portion of femur. Cornicles black, slightly incrassate at the base and with a dark green basal patch. The adult gradually becomes darker in color as it grows older and when it has about finished with the production of young it is almost black in color, having a slight greenish and brownish tint. Measurements (from alcoholic specimens collected on broom-corn at Mattoon, Ill., July 6, 1906): length of body, 2.363 mm.; width, 1.091 mm.; antenna~~e~~, I., 0.067; II., 0.054;

III., 0.193; IV., 0.115; V., 0.111; VI., basal, 0.077; filament, 0.176; total, 0.793 mm; cornicles, 0.203 mm.; style, 0.101 mm. The specimens reared in the insectary were somewhat smaller than the above.

Adult winged female.--Head black. Antennae black, and with six segments, or seven if the filament be counted. Antennal sensoria circular, sixteen to twenty on III., four on IV., several at apical end of V., and also at apical end of the basal part of VI. Eyes dark brown or black. Thorax and legs black. Abdomen pale bluish green. Three black spots on each side of the body and anterior to the cornicles, and a black basal spot surrounding each cornicle. Posterior to the cornicles are two black spots, one on each side, and also three more or less distinct transverse black bands. Cornicles black, slightly incrassate at middle, dilated at apex. Distal half of dorsally curved style black, and the remainder margined with black to the base. Measurements (alcoholic specimens): length of body, 1.709 mm.; width, 0.618 mm.; wing expanse, 5.786 mm.; antenna~~e~~, I., 0.065; II., 0.057; III., 0.293; IV., 0.154; V., 0.154; VI., basal, 0.106; filament, 0.228; total, 1.057 mm; cornicles, 0.130 mm.; style, 0.081 mm.

Pupa of winged female.--Body pale green. Head dark brown, with a more or less distinct median white line. Antennae darker at either end. Antennae with a sensorium at the end of V. and two or more at the distal end of the basal portion of VI. Wing-pads, tip of abdomen, and cornicles, black. Legs dark, almost black. Cornicles noticeably incrassate at middle and

slightly dilated at the tip. Measurements (alcoholic specimens): length of body, 1.999 mm.; width, 0.799 mm.; antennae, I., 0.067; II., 0.057; III., 0.183; IV., 0.125; V., 0.098; VI., basal, 0.084; filament, 0.159; total, 0.773 mm; cornicles, 0.155 mm.

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Aphis maidis Fitch.

Table IX

Data of individual experiments – viviparous generation – 1906.

Experiment number.	Date of birth.	Date of first young.	Immature period.	Date of last young	Young producing period.	Number of young.	Average number of young per day.	Largest number of young in one day.	Period after last young	Date of death or disappearance	Total length of life.	Food plant used.
3110′	28-29 June	6 July	7-8 days	12 July	7 days	18	2.6-	At least 3	0 days	12 July	14 days	Sorghum
3110″	9-10 July	15 "	5-6 "	4 Aug.	20 "	38	1.9	" " 5	13 "	17 Aug.	39 "	Broomcorn
3125	6 "	14 "	8 "	6 "	23 "	33	1.4+	" " 3	5 "	11 "	36 "	Sorghum
3129	9 "	14 "	5 "	30 July	16 "	22	1.3+	" " 2	11 "	11 "	32 "	"
3134	14 "	20 "	6 "	3 Aug	13 "	38	2.9+	" " 6	0 "	3 "	19 "	Broomcorn
3136	15 "	21 "	6 "	8 "	18 "	44	2.4+	" " 5	11 "	19 "	35 "	"
3141	27 "	1 Aug.	5 "	22 "	21 "	49	2.4-	" " 5	6 "	28 "	32 "	"
3145	25 "	31 July	6 "	18 "	18 "	35	2.-	" " 3	6 "	24 "	30 "	"
3154	31 "	7 Aug.	7 "	2 Sept.	26 "	38	1.5-	" " 4	0 "	2 Sept	45 "	"
3155	1 Aug.	7 "	6 "	11 Aug.	5 "	13	2.6	" " 4	0 "	11-13 Aug.	11 " *	"
3163	7 "	13 "	6 "	6 Sept.	24 "	47	1.9+	" " 5	1 "	8 Sept.	31 "	"
3164	7 "	14 "	7 "	20 Aug	7 "	26	3.7+	" " 6	0 "	20 Aug.	14 " *	"
3182	10 "	16 "	6 "	13 Sept.	28 "	49	1.7+	" " 4	8 "	21 Sept.	42 "	"
3170	13 "	19 "	6 "	30 Aug.	12 "	36	3.	" " 4	0 "	30 Aug.	18 "	"
3171	14 "	20 "	6 "	16 Sept.	27 "	47	1.7	" " 6	10 "	26 Sept.	43 "	"
3176	17 "	22 "	5 "	16 "	25 "	64	2.5+	" " 4	19 "	6 Oct.	49 "	"
3178	20 "	25 "	5 "	6 "	12 "	29	2.4+	" " 4	0 "	7 Sept	17 "	"
3179	20 "	27 "	7 "	23 "	27 "	65	2.4+	" " 5	7 "	30 "	41 "	"
3181	3-4 "	10 "	6-7 "	2 "	23 "	32	1.3+	" " 3	5 "	7 "	34 "	"
3183	22 "	29 "	7 "	9 "	11 "	14	1.2+	" " 3	0 "	9 "	18 "	"
3187	25 "	2 Sept.	8 "	12 "	10 "	17	1.7	" " 2	0 "	12 "	18 "	"
3188	27 "	7 "	11 "	8 "	2 "	5	2.5	" " X	0 "	8 "	13 "	"
3195	7 Sept.	14 "	7 "	26 "	12 "	28	2.3+	" " 4	0 "	26 "	19 "	"
3190	2 "	9 "	7 "	11 "	32 "	52	1.6+	" " 4	4 "	15 Oct.	43 "	"
3196	31 Aug.–2 "	8 "	6-8 "	18 "	10 "	23	2.3	" " 3	0 "	18 Sept.	16-18 "	"
3197	7 "	14 "	7 "	23 "	9 "	26	2.8+	" " X	0 "	23 "	16 "	"
3200	9 "	16 "	7 "	23 "	7 "	20	2.8+	" " 3	0 "	23 "	14 "	"
3201	9 "	15 "	6 "	5 Oct.	20 "	38	1.9+	" " 5	10 "	15 Oct.	36 "	"
3206	14 "	21 "	7 "	8 Nov.	48 "	59	1.2	" " 4	X "	8-13 Nov.	55 "	"
3210	16 "	24 "	8 "	15 Oct.	21 "	33	1.5+	" " 3	0 "	15 Oct	29 "	"
3216	24 "	4 Oct.	10 "	4 "	2 " *	X *	X	" " X	X "	5 "	11 " *	"
3215	21 "	28 Sept.	7 "	30 Sept.	3 " *	7	2.3+	" " X	X "	30 Sept.	10 " *	"
3216′	4 Oct.	16 Oct	12 "	17 Oct.	2 " *	4 *	2.	" " X	X "	17-22 Oct.	14 "	"
3220	23 Sept	2 "	9 "	28 "	26 "	35 *	1.3+	" " 4	37-44 "	3-10 Dec.	72 "	"
3221	23 "	2 "	9 "	13 Nov.	42 "	31	0.7+ *	" " 4	14 "	27 Nov.	65 "	"
3222	1 Oct.	11 "	10 "	12 Oct.	1 " *	1 *	1. *	" " X	X "	11-13 Oct.	11 " *	"
3229	17 "	1 Nov	15 "	2 "	1 " *	2 *	2. *	" " X	X "	3 Nov.	16 "	"
3230	20 "	28 Oct.–1 Nov.	8-12 "	27 Nov.	26-30 "	14+	X *	" " X	6 "	3-10 Dec.	44 "	"
3232	25 "	18 "	24 "	22 "	4 " *	3 *	0.7+ *	" " X	X "	22 Nov.	28 "	"
3234	1 Nov.	22-27 "	22-27 "	3-10 Dec.	X *	X *	X *	" " X	X "	10 Dec.	40 "	"
Average			8.15 "		19.0+ "	33.5	2.04+				31.6+ "	

* Not counted in making averages.

Aphis maidis Fitch.

Table X.

Line of generations - June 26 — November 22, 1906.

Generation in insectary	Date of birth.	Date of first young	Immature period.	Date of last young.	Period between first and last young.	Number of young.	Average number of young per day.	Largest number of young in one day.	Period after last young.	Date of Death or disappearance	Total length of life.	Food-plant used.
1	Collected on broomcorn, 26 June, 06	28-29 June				6						Sorghum
2	29 June	6 July	7 days.	12 July	7 days	18	2.6-	At least 3	0 days	12 July	14 days.	"
3	9-11 July	15 July	5-6 "	4 Aug.	20 "	38	1.9	" " 5	13 "	17 Aug.	39 "	Broom corn
4	15 July	21 July	6 "	8 Aug.	18 "	44	2.4+	" " 5	11 "	19 Aug	35 "	"
5	25 July	31 July	6 "	18 Aug.	18 "	35	2.-	" " 3	6 "	24 Aug	30 "	"
6	31 July	7 Aug.	7 "	2 Sept.	26 "	38	1.5-	" " 4	0 "	2 Sept.	33 "	"
7	7 Aug.	13 Aug.	6 "	6 Sept.	24 "	47	1.9+	" " 5	1 "	8 Sept.	31 "	"
8	13 Aug.	19 Aug.	6 "	30 Aug.	12 "	36	3.	" " 4	0 "	30 Aug.	18 "	"
9	19 Aug.	25 Aug.	5 "	6 Sept.	12 "	29	2.4+	" " 4	0 "	7 Sept.	17 "	"
10	25 Aug.	2 Sept.	8 "	12 Sept.	10 "	17	1.7	" " 2	0 "	12 Sept.	18 "	"
11	2 Sept.	9 Sept.	7 "	11 Oct.	32 "	52	1.6+	" " 4	4 "	15 Oct.	43 "	"
12	9 Sept.	16 Sept.	7 "	23 Sept.	7 "	20	2.8+	" " 3	0 "	23 Sept.	14 "	"
13	16 Sept.	24 Sept.	8 "	15 Oct.	21 "	33	1.5+	" " 3	0 "	15 Oct.	29 "	"
14	24 Sept.	4 Oct.	10 "	4 Oct.	2 "	1	0.5		0 "	4 Oct.	11 "	"
15	4 Oct.	16 Oct.	12 "	17 Oct.	2 "	4	2.			17-22 Oct.	14 "	"
16	16 Oct.	1 Nov.	15 "	2 Oct.	1 "	2	2.			3 Nov.	16 "	"
17	1 Nov.	Became adult 22 Nov. but disappeared before giving birth to any young.										"

Sipha (*Chaitophorus*) *flavus* Forbes.

The sorghum aphis was first described by Dr. S. A. Forbes, in 1883, in the Thirteenth Report of the State Entomologist of Illinois. Dr. Forbes has further mentioned it in several of his reports as State Entomologist, but so far as I know nothing else has been written about it.

The life-history was, until 1905, unknown, but during that year I made some studies upon this insect and found, among other things, that it passed the winter in the egg stage. In 1906 this aphid was first collected June 28, at Mattoon, Ill., by Mr. E. O. G. Kelly, on sorghum and *Panicum crus galli*, and the life-history from that date until the egg stage in the fall has now been obtained. The above date is not the earliest at which this aphid has been collected in the field, as Dr. Forbes has found it on grass as early as May 7. The eggs began to hatch, in the insectary, March 16, (1907), and it is probable that in the field the period of hatching is chiefly during the month of April.

Sorghum and broom-corn are the usual plants infested by this species, and upon these it is sometimes abundant and destructive. Dr. Forbes has reported it from sorghum, broom-corn, Indian corn, *Setaria*, *Panicum* and wheat. Mr. Kelly first reported its occurence on *Panicum crus-galli*, and in 1906 I reared it through a number of generations on *Panicum sanguinale*. This spring (1907) I placed young aphids, hatched from eggs, on

blue grass, and now, (May 17) they are still breeding freely on the grass; already three generations have been produced.

So far as has been recorded, this aphid has never been found outside of Illinois; in Illinois it has been reported from Urbana, Mattoon, Etna, Neoga, Effingham, Kinmundy, Centralia, Mt. Vernon, Fairfield, and Parker. As can be seen, these localities are all in the Southern half of the State; Urbana being the most northern locality.

As stated before, the aphids collected June 28 were placed in breeding cages on sorghum plants the next day and between this date and that of the last, ~~and~~ the oviparous, generation there was a maximum of eleven generations in one set of experiments and twelve in the other set. As the eggs hatch in April or May, it is quite certain that several generations had occured before these experiments were started. A full synopsis of these experiments is given in the following tables.

The cage used in rearing these aphids was a simple chimney cage, consisting of a pot of earth containing a young sorghum plant, over which was placed a lamp chimney closed at the top with a fine mesh cloth. Aphids were transferred from one plant to another by means of a soft camel's hair brush. The aphids would usually remain in the same place, even though the leaf became wilted or dying, and thus it was an easy matter to keep track of the aphids and obtain the numbers of young from day to day. Like-wise in the field this species migrates from one part of the plant to another only to a slight extent. The individuals are usually found on the older and lower leaves; also on the lower surface of the leaf

in groups, and almost always the young are found feeding on the leaf around the mother aphid. Another peculiarity of this species is that it is not attended by ants, as are most of the aphids found in the field.

There are two distinct kinds of generations, namely: the viviparous and the oviparous. The viviparous generation consists of females only (winged and wingless); they occur during the summer months; and they are exceptional in bearing living young parthenogenetically. The oviparous generation, consisting of both males and females, is the last generation in fall. In this generation copulation takes place and reproduction is carried on by means of eggs.

Viviparous generation:- All the following dat~~e~~a were obtained in 1906, unless otherwise stated. The length of time between birth of the aphid and its first young was between 7 and 13 days (in 1905 in some cases the maximum was 15 days) and the average for the entire thirty-two experiments was 9.3 days. This included those reared during the period between July 1 and Sept. 21. As the table shows, it required a longer time for them to reach maturity in the later and cooler parts of the season than it did earlier in the season. The average number of days required for development during the warmer parts of the year (July 1 to Sept. 1) was 8.8, while during the period between Sept. 1 and 21 it was 10.3 days. The period of time between the first and last young and also the period of the life of an individual vary in relation to temperature and season, i.e., they produce young for a greater length of time and live longer in the cooler parts of the year

than they do in the warmer season. The maximum period for the production of young, in my thirty-two experiments, was 51 days, while the average was 25 days. The maximum length of life of individuals in these same experiments was 101 days and the average was 46+ days. Larger numbers of young are produced by individual aphids and a larger average number of young are produced per day in the warmer parts of the year than in the cooler and later months. The total number of young produced by thirty-two females was 1802, or an average of 56.3 young per single female. The largest number of young per single female was 89. The average number of young produced by individual aphids in one day was 2.4+. In the experiments of 1906, the largest number of young produced in one day by a single aphid was six, but in 1905 as many as nine were born in one day. Almost without exception, the mother-aphid lived several days after the production of the last young. The number of molts was found to be invariably four, and, as will be seen in the accompanying table, the molts occurred, almost without exception, every two days. Eggs which were laid in the insectary in the fall were kept in the cold insectary all winter and began hatching March 16, 1907. In one line of generations, aphids hatched March 18 gave birth to young on April 15 (28 days); these aphids of the second generation became mothers May 16 (31 days). In another line, aphids hatched March 19 became mothers April 16 (28 days), and those of the second generation became mothers May 14 (28 days).

Oviparous generation,- The first aphids of the oviparous generation noticed, were born Sept. 24, 1906, though

in 1905 aphids of this generation were found as early as August 25. In all cases it required a longer time for the aphids of this generation to become adults than it did for the aphids of the viviparous generation, and this is largely due to temperature; growth being slower in the cooler parts of the year. The length of the immature stages varied from 15 to 40 days, the latter time, however, being very exceptional in length. The average time for the twenty-one cases in which an exact record was kept, was 19.5 days. Aphids were first observed in copula Oct. 18 and were noticed in copula occasionally until after Dec. 3. At this latter date the temperature in the room where the aphids were kept was 45° F. In 1905, the earliest record of copulation was Oct. 17. Eggs were first found soon after the first observations on copulation were made. As a rule, the eggs were laid on the under side of a sorghum leaf, but, as might be expected, there were some exceptions to this; for example, eggs were sometimes laid on the side of a cage and on the stem of a plant. The number of eggs laid by aphids, according to my observations, varied up to 14 and in nineteen cases the average was 8.3+ eggs per female. There was no definite period between the time of laying one egg to that of laying another. Usually, however, the interval was one of several days, temperature being the controlling factor. Upon the death of an aphid, in a number of cases, the body was examined for eggs, and with only one, or possibly two, exceptions, eggs were found in the body. My aphids always laid eggs until the temperature got down to 42° F. These facts indicate that there is no definite

number of eggs for an aphid to lay, but that eggs continue to be laid as long as the aphid lives, provided the temperature is not too low. Some aphids of this oviparous generation lived until January 17, 1907, though most of them died in November and December, 1906. During most of the month of December the temperature was down to the freezing point and consequently the aphids were in a dormant state; as the food plants were dead, the aphids certainly obtained no food during this time. The period of life was found to vary up to 83 days, the average, however, in seventeen cases, being 57.4+ days. The number of molts is the same in this generation as in the viviparous, namely, four. The accompaning table shows the periods between molts in the seven cases of which record was made.

Descriptions

Sipha (Chaitophorus) flavus Forbes

This aphid does not belong to the genus Chaitophorus, which has six antennal segments (or seven, counting the filament), and should doubtless be placed in the genus Sipha of Passerini, which is described as having five antennal segments, or six with the filament, the third segment and filament longest; cornicles tuberculiform.

Viviparous Generation

Before first molt and less than 24 hours old: Citron-yellow throughout. Legs and antennae somewhat transparent and of a lighter tint than the body color. Antennae apparantly only four-segmented. One sensorium is present at the extremity of the third segment. Eyes brownish red. Numerous tuberculate spines on the body, which are regularly distributed in longitudinal rows, there being six conspicuous rows in all: four dorsal and two lateral. Measurements:- not more than two hours old.- length of body, 0.618 mm.; width, 0.290 mm.; antenna, 0.270 mm.; lateral spines, 0.072 mm. Not more than 24 hours old: length of body, 0.690 mm.; Width 0.309 mm.; antenna, 0.290 mm.; lateral spines, 0.072 mm.

The young from eggs differ from the above (those

born alive) in that the general color is a dark green with black spinal markings and with black rings around the cornicles.

After first molt and 48-72 hours old: General color citron-yellow. Eyes brownish red. Antennae as before molt, except that there is now a slight constriction near the distal end of the third segment, where it later divides into two distinct segments; also, the circular sensorium at the distal end of the third is on a tubercle or short stalk-like process, and at the apex of the thickened base of the fourth segment is another circular sensorium. Five dark lines occur around the openings of the inconspicuous cornicles. Markings as before. Measurements: length of body, 1.05 mm.; width, 0.49 mm.

After second molt and 60-84 hours old: General color canary-yellow. Eyes brownish red. There are still only four distinct segments of the antennae and the constriction of the third segment is more distinct. Cornicles more distinct than in the earlier stages. Measurements: length of body, 1.45 mm.; width, 0.56 mm.; antenna, 0.43 mm.

After third molt and 124-148 hours old: General color canary-yellow. Eyes brownish red. The constriction of the third antennal segment becomes more distinct. Cornicles more distinct and almost as fully developed as in the adult. Measurements: length of body, 1.96 mm.; width, 0.74 mm.; antenna, 0.63 mm.; abdominal bristles, 0.127 mm.

Adult wingless viviparous female: General color canary-yellow.

Eyes brownish red. Antennae of the same general tint as the body, excepting the last segment which is darkened; ~~they are~~ five-segmented and ~~are~~ sparsely hairy, ~~but~~ the few hairs or bristles present ~~are~~ conspicuous. Beak short, not extending farther than the coxae of the middle pair of legs. Six conspicuous bristles project forward from the front of the head and between the bases of the antennae. Several less conspicuous hairs are found below those just mentioned. Dorsally are four longitudinal curving rows of black transverse markings, two rows on each side of the median line. Ten longitudinal rows of erect tubercular bristles are present on the dorsal and dorso-lateral sides of the thorax and abdomen. Cornicles short truncated cones, inconspicuous except for the dark ring around the opening. Measurements: length of body, 1.818 mm.; width, 0.763 mm.; antenna, I, 0.049; II, 0.049; III, 0.236; IV, 0.147; V, basal, 0.130; filament, 0.244; total, 0.855 mm.

Pupa of winged viviparous female: Head and thoracic segments olive-yellow; abdomen pale yellow with greenish tint. Eyes dark red. Antennae five segmented, all except last segment concolorous with head. Antennae and head with bristles, as in other forms. Thorax with several dark green patches from which arise tuberculate bristles. Legs, excepting tarsi, which are black, concolorous with body. Wing-pads light brown. Abdomen with eight longitudinal rows of tuberculate spines, each spine with a basal patch of dark green. A longitudinal row of small

transverse dashes occurs on each side between the first and second rows of spines, counting from the median line. Cornicles as in the other forms and with dark green basal patches. Measurements: length of body, 1.953 mm.; width 0.863 mm.; antenna, I, 0.058; II, 0.048; III, 0.194; IV, 0.135; V, basal, 0.107; filament, 0.214; total, 0.750 mm.

Winged viviparous female: Head and abdomen lemon-yellow, with the thoracic segments brownish. Eyes red. Antennae with several more or less noticeable hairs, much less conspicuous than in the wingless pseudogyne; all except the two basal segments and the basal half of the third segment ~~are~~ dark; a single circular sensorium at apex of fourth segment and several at the apex of the basal portion of the fifth segment. Beak hardly reaching to the coxae of the second pair of legs. Head and thorax with spinous tubercules much as in the wingless pseudogyne. Legs concolorous with body excepting tips of tarsi which are darkened. Stigma and cubitus pale yellow, other wing veins dusky. Abdomen with eight longitudinal rows of dark green spots from which arise conspicuous tuberculate spines. Between the first and second rows of spots from the median line, on each side, is a row of small dark dashes. Cornicles tuberculiform and with dark green basal patches. Style slightly constricted in the middle. Measurements: expanse of wings, 5.744-6.477 mm.; length of body, 1.641 mm.; width, 0.734 mm.; antenna, I, 0.065; II, 0.065; III, 0.277; IV, 0.196; V, basal, 0.147; filament, 0.293,

total, 1.043mm.; style, 0.088 mm.

Oviparous Generation.

Before first molt and 24-48 hours old; male or female: Color sulphur-yellow. Head with a dark patch covering it almost entirely. Eyes red. Antennae and legs are transparent until a day old, gradually darkening until they become concolorous with the darker markings of the body. Antennae apparently only four-segmented; a constriction in the apical half of the third segment shows where this segment later divides into two. At the distal end of the third segment is a distinct sensorium, while at the apex of the thickened base of the fourth are one or more indistinct sensoria. Thorax with dark patches covering about one-half the dorsal surface. Abdomen with dark markings which appear only after the aphid is at least one day old. Abdomen with four distinct dorsal rows of tuberculate spines, two on either side of the median line, and at least one lateral row on each side. At the base of each of these spines is a small darkened area. The small indistinct cornicles are surrounded with dark circular patches. The opening also is marked by a dark ring. Measurements: length of body, 0.763.; width, 0.362 mm.

Female. After second molt and seven or eight days old. General color light apple-green. Antennae lighter than body color, excepting second segment and tip of the last

segment. Spine spots bice-green in color. Tarsi black. Measurements: length of body, 1.331 mm.; width, 0.581 mm.; antenna, 0.537 mm.

Female. After third molt: General color apple-green, becoming paler and with a yellowish tint at the caudal end. Head lighter than body color. Eyes reddish brown. Antennae pale, excepting the last segment, which is darkened. That segment which in the earlier stages represents the third is now indistinctly separated into two segments. The sensorium at the distal end of the fourth (the third of the earlier stages) is quite distinct. The apex of the thickened base of the last segment has numerous distinct sensoria. Legs pale, excepting tarsi which are black. Cornicles more distinct. Measurements: length of body, 1.775 mm.; width, 0.725 mm.

Adult wingless oviparous female: Head, first two thoracic segments and tip of abodmen oil-green ~~color~~. Abdomen parrot-green, shading at extremities to oil-green. Eyes dark reddish brown. Antennae five-segmented; one sensorium at distal end of fourth and several at end of basal part of the fifth; bristles few but conspicuous, there being two on each of the two basal segments, three or four on the third and one on the fourth. Projecting forward from the head and between the bases of the antennae are six distinct bristles. Beak short, not extending farther than the coxae of the second pair of legs. On the dorsal surface of the body are four rows

of small transverse dashes, two on each side of the median line; also eight rows of tuberculate bristles, four on each side of the median line. Hind tibiae noticeably swollen and bearing numerous circular sensoria. Style upcurved. Cornicles as in all the other forms of this species. Measurements (alcohalic specimens): length of body, 1.67 -1.92 mm.; width, 0.72-0.83 mm.; antenna, I, 0.065; II, 0.065; III, 0.244; IV, 0.130; V, basal, 0.106; filament, 0.236; total, 0.846 mm.; style, 0.078 mm.

Male. After second molt and eight or nine days old: General color citron-yellow. Antennae five-segmented. Sensoria at end of fourth and at distal end of the thickened base of the fifth segment. Measurements: length of body, 1.098 mm.; width, 0.469 mm.

Male. After third molt: General color sulphur-yellow, ~~tinging~~ shading ~~with~~ to greenish at extremities. Eyes brownish red. Other markings as in earlier stages. Measurements: length of body, 1.603 mm.; width, 0.744 mm.; antenna, I, 0.067; II, 0.057; III, 0.162; IV, 0.133; V, basal, 0.095; filament, 0.191; total, 0.705 mm.

Adult male: General color bright lemon. Eyes dark reddish brown. Antennae usually as long as body, the two basal segments concolorous with the body and the others dark; antennae with a few conspicuous hairs, there being two on each of the two basal segments, five on the third and either one or two on the fourth; circular sensoria numerous (at least forty) and irregularly placed on the

third, fifteen to twenty on the fourth, and a number at the distal end of the thickened base of the fifth segment. Beak short, not reaching farther than the coxae of the second pair of legs; its tip dark, the rest concolorous with the body. Six distinct bristles project forward from the front of the head and between the bases of the antennae. On the dorsal surface of the body are eight rows of tuberculate bristles, four on each side of the median line. There are also two rows of dark oval markings on each side of the median line. Measurements (alcoholic specimens): length of body, 1.12-1.30 mm.; width, 0.45-0.50 mm.; antenna, I, 0.081; II, 0.065; III, 0.407; IV, 0.220; V, basal, 0.106; filament, 0.350; total, 1.229 mm.

Egg: Color when first laid pale green, with a small dark spot of obscure form showing through the egg shell at one end. The egg gradually darkens until it becomes a jet black. There is no noticeable change in color just before the young hatch. Form elliptical-oval. Measurements: length, 0.652 mm.; width, 0.3015 mm.

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1906 Sanborn, C. E. Kansas Aphididae with Host-Plant and Plant-Host List. Kansas Uni.Sci.Bull.,vol.3.,no.8,part 2. Food-plants of *Chaitophorus flavus* Forbes given as cultivated corn,cultivated sorghum and *Sorghum halpense* L.

Sipha (Chaitophorus) flavus Forbes.

Table XI.

Data of all individual experiments, viviparous generation, for 1906.

Date of birth	Date of first young	Period between birth and first young.	Last young.	Period between first and last young.	Number of young.	Average number of young per day.	Length of life after last young.	Total length of life
1 July	12 July	11 days	18 July	6 days	14	2.3+	0 days	17 days
9-10 "	19 "	9-10 "	25 "	6 "	15	2.5	0 "	15-16 "
12-15 "	21 "	8-9 "	25 "	4 "	9	2.2+	0 "	12-13 "
18 "	27 "	9 "	16 Aug.	20 "	49	2.5-	2 "	29 "
19 "	27 "	8 "	4 "	8 "	28	3.5	0 "	16 "
21 "	31 "	10 "	24 "	24 "	68	2.8+	1 "	34 "
27 "	4 Aug.	8 "	26 "	22 "	65	2.9+	13 "	43 "
27 "	4 "	8 "	28 "	24 "	65	2.7+	27 "	59 "
31 "	8 "	8 "	30 "	22 "	59	2.7+	2 "	32 "
6 Aug.	15 "	9 "	9 Sept.	25 "	73	2.9+	13 "	47 "
4 "	13 "	9 "	9 "	27 "	80	3.-	10 "	46 "
8 "	16 "	8 "	16 "	31 "	77	2.5+	14 "	53 "
13 "	21 "	8 "	13 "	23 "	78	3.3+	0 "	31 "
15 "	23 "	8 "	20 "	28 "	89	3.1+	8 "	44 "
16 "	24 "	8 "	13 "	20 "	49	2.5-	0 "	28 "
14-16 "	22 "	6-8 "	11 "	20 "	60	3.	14 "	42 "
21 "	30 "	9 "	23 "	24 "	83	3.4+	21 "	54 "
22 "	2 Sept.	11 "	4 Oct.	32 "	83	2.6-	15 "	58 "
23 "	1 "	9 "	28 Sept.	27 "	79	2.9+	27 "	63 "
24 "	4 "	10 "	3 Oct.	29 "	67	2.3+	11 "	50 "
30 "	9 "	10 "	14 "	35 "	63	1.8	31 "	76 "
2 Sept.	10 Sept.	8 d "	6 "	26 "	75	2.8+	27 "	61 "
2 "	11 "	9 "	30 Sept	19 "	58	3.+	1 "	29 "
6 "	14 "	8 "	7 Oct.	23 "	69	3.	13 "	44 "
9 "	18 "	9 "	8 Nov.	51 "	58	1.+	38 "	98 "
10 "	19 "	9 "	29 Sept.	10 "	35	3.5	2 "	21 "
11 "	21 "	10 "	31 Oct.	40 "	50	1.2+	51 "	101 "
10-11 "	23 "	12-13 "	29 Sept.	6 "	16	2.6+	0 "	18-19 "
14 "	24 "	10 "	3 Nov	40 "	44	1.+	24-25 "	74-75 "
18 "	2 Oct.	14 "	17 "	46 "	32	0.6+	28 "	94 "
19 "	30 Sept.	11 "	20 "	51 "	56	1.+	31 "	93 "
21 "	4 Oct.	13 "	10 "	37 "	56	1.5+	41 "	91 "
Average		9.3 "		25.2- "	53.1+	2.48		46+ "

Sipha flavus Forbes.

Table XII.

Line of generations. June 28 – December 21, 1906.

Generation in insectary	Date of birth.	Date of first young.	Period from birth to adult.	Last young	Period from first to last young	Number of young	Average number of young per day.	Largest number of young in one day.	Life after last young	Entire length of life.	Date of death. or disappearance	Plant used
1	Collected on sorghum at Mattoon, IN, 28 June 1906.											Sorghum
2	X	8 July	X	18 July	10 days	18	1.8	3	X	at least 19 days	19 July	..
3	9 or 10 July	19 July	9 or 10 days	25 July	7 ..	15	2.+	3	0 days	16 or 17 ..	25 July	..
4	19 July	27 July	8 ..	4 Aug	9 ..	28	3.+	4	0 ..	17 ..	5 Aug.	..
5	27 July	4 Aug.	8 ..	28 Aug	24 ..	65	2.6+	5	27 ..	59 ..	24 Sept.	..
6	4 Aug.	13 Aug.	9 ..	9 Sept.	27 ..	80	3.-	6	10 ..	46 ..	19 Sept.	..
7	13 Aug.	21 Aug.	8 ..	13 Sept.	23 ..	78	3.3+	6	0 ..	31 ..	13 Sept.	..
8	21 Aug.	30 Aug.	9 ..	23 Sept.	24 ..	83	3.4+	6	21 ..	54 ..	15 Oct.	..
9	30 Aug.	9 Sept.	10 ..	14 Oct.	35 ..	63	1.8	5	31 ..	76 ..	16 Nov.	..
10	9 Sept.	18 Sept.	9 ..	26 Oct.	38 ..	56	1.5	4	51 ..	98 ..	16 Dec.	..
11	18 Sept.	3 Oct.	14 ..	17 Nov.	46 ..	32	0.6+	4	34 ..	94 ..	21 Dec.	..
12	3 Oct.	Oviparous generation.			Of the five aphids in the cage, four became adult males – 16–18 Oct. '06. These are all removed 21 Oct. '06.							..

Sipha flavus Forbes.

Table XIII.

Periods and Succession of Generations. 1906.

Number of the generation	June	July	August	September	October	November	December	Number of days in existence.
1 *	25	18						20
2		1 – 18						18
3		12	18					37
4		21		25				66
5		31			19			81
6			8				10	124
7			16		28			73
8			24				21	119
9				6			21	106
10				14			21	98
11				24			21	88

* First generation in insectary but not the first from the egg.

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Table XIV.

Periods of Molts - Viviparous generation. 1906.

Date of birth.	Date of first molt.	Date of second molt.	Date of third molt	Date of fourth molt	Date of first young.	Total immature period.
9 Aug.	11 Aug.	13 Aug.	15 Aug.	before 8^{00} A.M. 17 Aug.	1^{30} P.M. 17 Aug.	8 days.
4 Aug.	5 Aug.	7 Aug.	9 Aug.	before 9^{45} A.M. 11 Aug.	3^{30} P.M. 11 Aug.	7 days.
4 Aug.	6 Aug.	8 Aug.	10 Aug.	10.^{45} A.M. 12 Aug.	8^{30} A.M. 13 Aug.	8 days.
12 Aug.	14 Aug.	16 Aug.	18 Aug.	before 7^{45} A.M. 20 Aug.	10^{00} A.M. 20 Aug.	8 days.
12 Aug.	14 Aug.	16 Aug.	18 Aug.	8^{30} A.M. 20 Aug.	11.^{45} A.M. 20 Aug.	8 days.

Sipha flavus Forbes.

Table XV.

Oviparous generation. 1906.

When born.	Date it became adult	Period from birth to adult.	Dates of copulation if obtained.	Date of death or disappeared.	Total length of life.	Sex	Remarks.
16 Oct.	3 Nov.	18 days.	7 Nov. 17 Nov.	13 Dec.	57 days.	♂	
16 Oct.	7 Nov.	22 ..	27 Nov. – 55°F. 28 Nov. – 54°F.	17 Dec.	61 ..	♀	At least five eggs.
12 Oct.	28 Oct.	16 ..	4 Nov. 15 Nov. 16 Nov.	23 Nov.	42 ..	♀	At least nine eggs.
14 Oct.	30 Oct.	16 ..		♂ 1 Nov.	18 ..	1 ♂ and 1 ♀	
14 Oct.	2 Nov.	19 ..		♀ 28 Nov.	45 ..		
15 Oct.	31 Oct.	16 ..	8 Nov.	5 Dec.	51 ..	♂	
15 Oct.	1 Nov.	17 ..	18 Nov.	5 Dec.	51 ..	♀	
13 Oct.	28 Oct.	15 ..	4 Nov.	21 Dec.	69 ..	♀	Twelve eggs.
29 Oct.	8 Dec.	40 ..		19 Dec.	51 ..	♀	
19 Oct.	16 Nov.	28 ..		10 Jan. '07	83 ..	♀	
19 Oct.	17 Nov.	29 ..		21 Dec.	63 ..		
9 Oct.	23-27 Oct.	14-18 ..		3 Nov.	25 ..	♀	
24 Sept.	8-15 Oct.	14-21 ..	18 Oct. 22 Nov.	12 Dec.	79 ..	♀	Fourteen eggs.
24 Sept.				26 Oct.	32 ..		Ten eggs.
24 Sept.			23 Oct. 7 Nov. 27 Oct.	2 Nov.	39 ..	♀	All three aphids laid at least
24 Sept.			28 Oct. 1 Nov.	18 Oct.	55 ..	♀	twenty-two eggs and eight were
24 Sept.			5 Nov. 3 Dec. – 45°F	12 Dec.	79 ..	♀	found in their bodies
2 Oct.	18 Oct.	16 days.	25 Oct. 18 Nov. 30 Oct. 5 Nov.	21 Dec.	81 ..	♀	At least eleven eggs.
4 Oct. (4) 5 Oct. (1) 6 Oct. (1)	21 Oct. (5) 22 Oct.	17 .. (4) 16 .. (1) 16 .. (1)	3 Nov. 12 Nov.	3 Nov. (4) 21 Dec (2)	30 .. (4) 77 .. (1) 76 .. (1)	♀ (6)	Figures in parenthesis refer to number of individuals. Total number of eggs laid 31. One individual laid at least 10 eggs.
Average.		19+ days			52+ days		

Sipha flavus Forbes.

Table XVI.

Periods of Molts – Oviparous generation 1906.

Date of birth.	Date of first molt.	Number days.	Date of second molt	Number days.	Date of third molt.	Number days.	Date of fourth molt.	Number days	Total immature period.
12 Oct.	15 Oct.	3	18 Oct.	3	22 Oct.	4	28 Oct.	6	16 days.
13 Oct.	16 Oct.	3	18 Oct.	2	22 Oct.	4	28 Oct.	6	15 days.
14 Oct.	17 Oct.	3	21 Oct.	4	26 Oct.	5	2 Nov.	7	19 days.
14 Oct.	17 Oct.	3	20 Oct.	3	24 Oct.	4	30 Oct.	6	16 days.
19 Oct.	25 Oct.	6	30 Oct.	5	5 Nov.	6	16 Nov.	11	28 days.
19 Oct.	25 Oct.	6	31 Oct.	6	6 Nov.	6	17 Nov.	11	29 days.
29 Oct.	4 Nov.	6	9 Nov.	5	21 Nov.	12	8 Dec.	17	40 days.
Average		4.3		4.		5.8		9.1	23+ days

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